Slinging in Terrain

Self-Leveling Spreader Beam
for Adjusting the Orientation of an Overhead Crane Load

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What already exists?

• H-frame
What already exists?

- H-frame
- Die Turner
What already exists?

- H-frame
- Die Turner
- Spreader Beam with fixed slings
Can something better be made?

• Reorient crane load in-air
Can something better be made?

• Reorient crane load in-air

• Remote Operation
Can something better be made?

• Reorient crane load in-air
• Remote Operation
• Automatically balancing
Can something better be made?

- Reorient crane load in-air
- Remote Operation
- Automatically balancing
- Easy to use
<table>
<thead>
<tr>
<th>Subsystems</th>
<th>Support frame</th>
<th>Solutions</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>rectangular</td>
<td></td>
</tr>
<tr>
<td></td>
<td>gimbal</td>
<td></td>
</tr>
<tr>
<td></td>
<td>none</td>
<td></td>
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<tr>
<td></td>
<td>arc-shaped</td>
<td></td>
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<tr>
<td></td>
<td>tubular</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Sling shortening method</th>
<th>Screw</th>
<th>rope drum</th>
<th>twisting</th>
<th>pulley</th>
<th>gear</th>
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</thead>
<tbody>
<tr>
<td>Number of lifting slings</td>
<td>3 pcs</td>
<td>4 pcs</td>
<td>8 pcs</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Degrees-of-freedom</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hoist method</td>
<td>straps</td>
<td>chains</td>
<td>strings</td>
<td>cables</td>
<td></td>
</tr>
<tr>
<td>Orientation sensing method</td>
<td>sensor on load</td>
<td>sensor in frame</td>
<td>inclinometers on the slings</td>
<td>camera on frame</td>
<td></td>
</tr>
<tr>
<td>Powering method</td>
<td>battery on frame</td>
<td>cable to crane superstructure</td>
<td>cable straight from wall</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
1. frame
2. 4 winches
3. 2 linearly moving trolley assemblies
4. 2 linear rails
5. 2 stepper motor driven ball screw assemblies
6. frame mounted inertial measurement unit
7. microcontroller
8. 2 relay modules
9. Bluetooth module
10. 4 hook rigging points
Bluetooth Controller
Proof of concept
Relay modules
Stepper control
Load under frame
Load rotated
Frame balanced
Discussion

• Microcontroller capability
Discussion

- Microcontroller capability
- Potentiality to execute the task
Discussion

• Microcontroller capability

• Potentiality to execute the task

• Diversify the range of crane use
Future steps

• Perpendicular linear movement
• Closed-loop control
• Logic to take main crane into account
• Power with batteries
• Implement sensor data filtering
• Optimize component selection
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Questions?